Quality Assurance Project Plan (QAPP) Interim Measures Additional Sampling and Equalization Lagoon Closure Monitoring

prepared for

Arvin Meritor Inc.

November 2000

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QUALITY ASSURANCE PROJECT PLAN (QAPP)
INTERIM MEASURES ADDITIONAL SAMPLING AND EQUALIZATION LAGOON CLOSURE MONITORING

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November 2000

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1.0 Title and Approval Page

Document Title: Quality Assurance Project Plan for the Interim Measures Additional Sampling and Equalization Lagoon Closure Monitoring

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Consultants, Engineers, and Scientists

February 1, 2001

Rec'd Feb. 9, 2001

Mr. Dale Showers
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Dear Mr. Showers:

Please find enclosed the final QAPP for Grenada Manufacturing. Caleb Dana and I have signed on page 1-1. However, I wanted to bring a change in *Eco·Systems* personnel to your attention. The organizational chart in Section 4.1 identifies Wade Steinriede as the Task Manager for *Eco·Systems*. However, the Task Manager is now Charles Coney.

Sincerely,

Carol Bullock

Carol Bullock
Staff Scientist

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Appendix A: Field Parameter Operation Manuals

3.0 Distribution List and Project Personnel Sign-off Sheet

The following is the distribution list for the QAPP.

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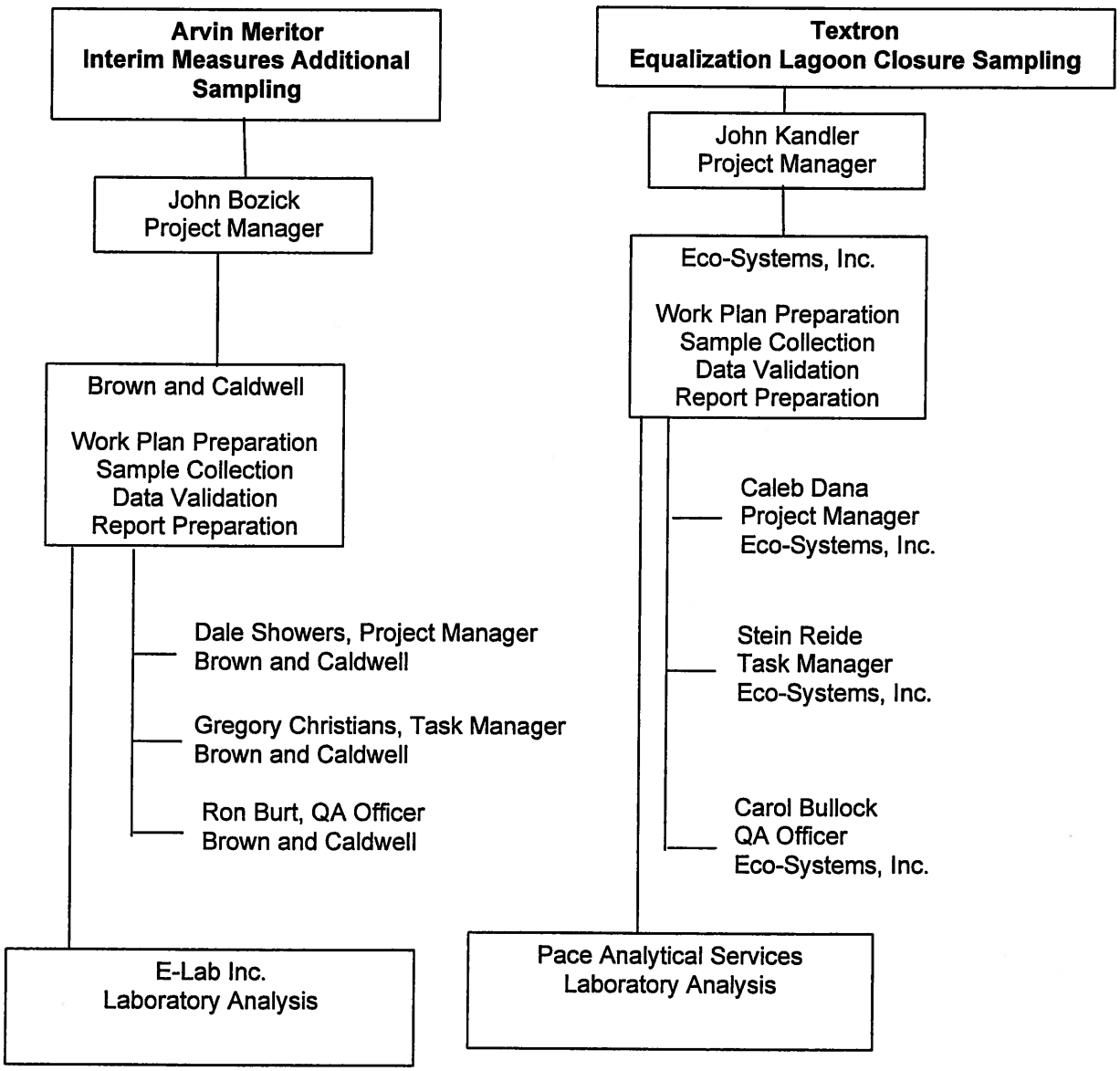
4.0 Project Organization

The organizations and key individuals involved in the Interim Measures (IM) Additional Sampling and Equalization Lagoon Closure Sampling are set forth in the organizational chart below.

Figure 4-1 Organizational Chart for Interim Measures Additional Sampling and Equalization Lagoon Closure Monitoring



Laboratories:

The laboratories listed below have been selected for this IM Additional Sampling and Equalization Lagoon Closure Sampling. Laboratories will be subcontracted by Brown and Caldwell and Eco-Systems to provide analytical services.

Interim Measures Work Plan

E-Lab Inc.
Rick Davis – Laboratory Director
Peter Ciarleglio – Quality Assurance Officer

Equalization Lagoon Closure

Pace Analytical Services, Inc.
Jim Neulgan - Laboratory Manager
Gary Newton – Quality Assurance Officer

Responsibilities:

Arvin Meritor

Arvin Meritor, as the primary party, has complete oversight of the project RCRA activities for the site.

Mr. John Bozick is the Project Manager. Mr. Bozick's duties are to ensure the overall satisfactory completion of the project. Mr. Bozick has complete authority over all actions taken at the site, including:

- Managing the development of the Work Plan.
- Contracting and management oversight of Work Plan Design, Reporting, Data Validation and Field Investigation activities.
- Obtaining approvals from local, state and federal authorities for all phases of work.
- Communicating with local, state and federal authorities on all matters relating to the project.
- Presenting the final report to authorities.

Textron

Textron has primary oversight responsibilities for the Equalization Lagoon Closure monitoring at the site.

Mr. John Kandler is the Environmental Coordinator and is the Project Manager for the Equalization Lagoon Closure monitoring. Mr. Kandler duties are to ensure the overall satisfactory completion of the closure activities. Mr. Kandler has complete authority over all actions taken at the site relation to the Equalization Lagoon Closure, including:

- Managing the development of the Equalization Lagoon Closure monitoring.

- Contracting and management oversight of Work Plan Design, Reporting, Data Validation and Field Investigation activities.
- Obtaining approvals from local, state and federal authorities for all phases of work.
- Communicating with local, state and federal authorities on all matters relating to the project.
- Presenting the final report to authorities.

Brown and Caldwell (BC)

Brown and Caldwell's responsibilities relate only to RCRA Corrective Action activities for the site and include:

- Prepare draft, final draft, and final work plans.
- Secure analytical laboratories.
- Perform sample collection activities.
- Perform sample data validation.
- Prepare draft, final draft, and final reports.

ECO-Systems Inc.

ECO-Systems Inc. responsibilities relate only to the Equalization Closure monitoring activities and include:

- Prepare draft, final draft, and final work plans.
- Secure analytical laboratories.
- Perform sample collection activities.
- Perform sample data validation.
- Prepare draft, final draft, and final reports.

5.0 Background Problem Definition

This project is to (1) provide supplemental information for the evaluation and implementation of the RCRA Correction Action interim measures and (2) continue groundwater monitoring for the RCRA Equalization Lagoon Closure at the Grenada Manufacturing Site.

5.1 Description of Current Site Status

5.1.1 Site Investigation and RCRA Corrective Action

Rockwell Automotive North America, now Arvin Meritor, Inc. operated a wheel cover manufacturing facility in Grenada, Mississippi from 1966 to 1985 before selling the operations and property to Textron Automotive Company, formerly Randall Textron, who then sold the operations and property to Grenada Manufacturing, LLC in 1999. Grenada Manufacturing, LLC (Permittee) continues to operate the wheel cover plant. Arvin Meritor, Inc. and Textron Automotive Company have conducted a number of environmental investigations at the referenced facility. The most extensive investigative work is reported in the 1994 Remedial Investigation (RI) Report conducted by ECKENFELDER INC., now known as Brown and Caldwell (BC). The work was in response to an Mississippi Department of Environmental Quality (MDEQ) Administrative Order on Consent designed to investigate the on-site landfill, and was subsequently expanded to include other areas of the Site.

The RI conducted by ECKENFELDER INC. in January 1994 identified the presence of trichloroethylene (TCE) and its degradation products, as well toluene and chromium in the soil and groundwater at the Site. A Baseline Risk Assessment (BRA) was performed for soil and upper-site groundwater as part of the Supplemental RI report prepared by ECKENFELDER INC. in March 1994. The baseline risk assessment provides an evaluation of the potential threat to human health and the environment of the constituents of interest at the Site. The risk assessment identifies the constituents of interest and, through the exposure and toxicity assessments, characterizes the associated potential risk, assuming no action is taken at the Site. The primary concern with respect to impacted groundwater is the migration of chlorinated ethenes and ethanes to Riverdale Creek. Toluene and chromium are also of concern, but are present at much lower concentrations than are the chlorinated volatile organic compounds (VOCs) and do not threaten Riverdale Creek. The results of that investigation are discussed on a site-wide basis in the RI Report. The solid waste management units (SMWUs) and areas of concern (AOCs) had not yet been determined at the time the report was submitted to the MDEQ.

Subsequent to the submittal of the RI Report, the facility became subject to regulation under RCRA Corrective Action and a RCRA Facility Assessment (RFA) was performed by USEPA's contractor (A.T. Kearney, Inc., 1997) as part of the HSWA permit process for the facility in 1996 and 1997. As a result of the Preliminary Review (PR) and Visual Site Inspection (VSI), 26 SWMUs and 3 AOCs were identified.

On March 2, 1999, USEPA issued a combined RCRA Facility Investigation (RFI)/Confirmatory Sampling (CS) Work Plan call letter. Arvin Meritor and Textron requested a meeting at the Region IV office to review the results of the RI conducted for MDEQ and to identify potential data

gaps. During a meeting held on May 13, 1999 among the USEPA Region IV Project Manager, and representatives from Textron Automotive, Arvin Automotive, and BC, it was agreed that nearly all of the information that might be generated in an RFI/CS effort already existed. USEPA requested that summaries of data obtained subsequent to issuance of the 1994 RI Report be prepared and that the available data be organized by SWMU or AOC. That document, the Summary of Investigative Work (SOIW), was prepared by BC in response to that request and was transmitted to USEPA and MDEQ in July 1999.

A portion of the site's groundwater is currently impacted by TCE and its degradation products. Additionally, there is a portion of the Site where chromium impacts groundwater. Groundwater at the Site appears to discharge primarily to Riverdale Creek. Potential impact to the creek appears to be limited to TCE and its degradation products. Groundwater may also enter the outfall ditch, which discharges to Riverdale Creek. Impact to Riverdale Creek due to discharge of groundwater containing TCE and its degradation products has been identified as an environmental condition that could benefit from implementation of an Interim Remedial Measure.

5.1.2 Equalization Lagoon History/Background Information

Prior to its closure, the Equalization Lagoon measured approximately 525 feet long by 225 feet wide, with a depth of approximately 10 feet. The approximate capacity of the unit was 2,500,000 gallons. The Equalization Lagoon was constructed with seven influent pipes from the facility, and two effluent pipes in the basin. One effluent pipe discharged to the on-site wastewater treatment system while the other effluent pipe served as the overflow outfall line.

The Equalization Lagoon was designed to handle a maximum flow of 500,000 gallons per day. Actual flow averaged approximately 360,000 gallons per day. The majority (70%) of this flow came from the Butler wash and buff operations. The remaining flow was comprised of wastewater from the roll department, boil-off, chrome electroplating and boiler operations. The wastewater influent to the lagoon remained essentially unchanged until July 20, 1990. At that time the wastewaters from the chromium electroplating, roll department and boiler (about 20%) were routed directly to the wastewater treatment system.

In July, 1991 all wastewaters were routed directly to the treatment system. The lagoon was dewatered by directing the remaining lagoon effluent to the treatment system. No wastewaters were discharged into the lagoon after July, 1991. Stormwater runoff that entered the lagoon was directed to treatment.

In May, 1994 ***SECOR*** began lagoon closure activities according to the approved Modified Closure Plan by isolating and stabilizing the waste sludge and soils using quick lime, and enclosing the material in a lined, capped cell within the bounds of the former lagoon. The entire site was seeded and mulched to complete the closure construction activities on November 19, 1994. A Closure Report dated December 9, 1994, documenting the closure activities was submitted to the State of Mississippi's Office of Pollution Control.

The geology of the site was evaluated when five monitoring wells were installed around the Equalization Lagoon during December, 1991 and March, 1992. Lithologic descriptions shown on the boring logs indicate that clayey or silty soils exist from the ground surface to a varying depth

between 5 and 6 feet below surface grade (BSG). Underlying the silt and clay layers is a medium grained sand layer. This layer extends to a depth of at least 20 feet BSG (the extent of the borings). The boring logs indicate that the shallowest continuous water bearing layer is this sand layer.

The water table was encountered in the borings between 10 and 16 feet BSG. Groundwater level measurements have been conducted periodically since installation of the existing shallow groundwater monitoring wells (MWRT-1, MWRT-2, MWRT-3, MWRT-4, and MWRT-5). Based on interpretation of these measurements, groundwater flows toward the northwest.

Given this information the existing groundwater monitoring wells were identified in relation to their position upgradient or downgradient of the lagoon.

Well Identification	Gradient and Direction from the Lagoon
MWRT-1	Up and East
MWRT-2	Cross and South
MWRT-3	Cross and South
MWRT-4	Down and West
MWRT-5	Down and North

These wells were sampled and analyzed monthly for comparison to quality objectives for volatile organic compounds, indicator parameters and metals. Levels of chromium in the groundwater collected from monitoring wells located south of the former Equalization Lagoon were shown to exceed the USEPA maximum contaminate level (MCL) for chromium (0.1 mg/L), while levels of chromium in the groundwater collected from the downgradient and east wells were shown to be below the USEPA MCL for chromium. All groundwater samples collected from both upgradient and downgradient monitoring wells had levels of TCE exceeding the USEPA MCL for TCE (0.005 mg/L). The highest levels of TCE were detected in the southern wells. Monitoring well RT-1 located upgradient and east demonstrated the lowest TCE levels.

A summary of past data collected from the sludge and subsoils in the lagoon as well as water quality from the monitoring wells in the vicinity of the lagoon are provided in Table 5-1 and 5-2.

5.2 Problem Definition

5.2.1 Additional Sampling for Interim Measures

Currently, there is insufficient information to evaluate Interim Measures. Specifically, more detailed information is needed regarding the horizontal and vertical distribution of VOCs and chromium (+6). This data could be provided through a sampling program using direct-push methods. The same sampling event will also be used to define the top and bottom of the shallow aquifer, as the thickness of the saturated interval and the depths to groundwater and the aquitard are important considerations in selecting a technology with respect to feasibility of construction methods. Further, existing data should be used to model groundwater flow, as the seepage velocity is critical to performance feasibility of some technologies. Additional soil data from the Site, including any of the SWMUs, would not be beneficial because they are all located substantially upgradient of the likely locations of the IM. Furthermore, in some cases it would be

difficult to assess whether constituents found in soil samples evolved from the SWMU or as a result of groundwater transport from an up-gradient source.

The proposed additional sampling event will supplement the RFI by including sampling and analysis of existing monitoring wells site-wide to provide current data regarding the distribution of key constituents in groundwater and will help identify trends in constituent concentrations throughout the plume. However, these data will not extend delineation to areas where an IM might be implemented. It is important to extend the delineation (utilizing direct-push technology) of TCE and its daughter products in two areas: (1) south from the outfall ditch along Riverdale Creek and (2) between the creek and the sludge lagoon. Both vertical and horizontal delineation are needed to select and design an IM. For example, zero valence metal barriers require sufficient retention time to achieve adequate reductions in constituent concentrations. The needed retention time depends upon the degradation rates and the concentrations of constituents entering the treatment system. The retention time achieved is dependent upon the groundwater seepage velocity and the thickness of the treatment system. These factors can determine whether such a system is appropriate for a specific Site or specific area of the Site. No long-term groundwater monitoring is proposed for that area at this time. Once an IM has been selected, a long-term groundwater monitoring program will be designed to meet the monitoring needs of the IM.

Detailed descriptions of the direct-push program and site wide groundwater sampling are presented in Section 6.0.

5.2.2 Equalization Lagoon Closure Project Objectives and Scope

The purpose of this monitoring program is to demonstrate the effectiveness of the Equalization Lagoon Closure over the next thirty years, as required by RCRA standards.

In order to achieve this goal, monitoring is required to ensure the appropriate performance and design of the constructed cell unit. The process of testing requires multiple sampling and analysis events to support statistical evaluation of the impact, if any, of the closure.

Table 5-1 1992 – 1994 Data Summary – Organic Concentration Ranges

Chemical	Sludge (ppm)	Subsoil (ppm)	Monitoring Well RT-1 (µg/L)	Monitoring Well RT-2 (µg/L)	Monitoring Well RT-5 (µg/L)	Monitoring Well RT-4 (µg/L)
Benzene	ND	ND	<5.0	<5000	<250	<250
1,1-Dichloroethane	ND	ND	<5.0	<5000	<250	<250
t-1,2-Dichloroethene	DNA	DNA	<5.0-5.8	2600-5700	<50-5200	3000-5400
c-1,2-Dichloroethene	DNA	DNA	<5.0	<5000	<5000	<250
Ethylbenzene	0.40-0.98	ND	<5.0	<5000	<5000	<250
Methylene Chloride	0.29-1.4	0.006-3.4	<5.0	<5000	<5000	<250
Tetrachloroethene	ND	ND	<5.0	<5000	<5000	<250
1,1,2-Trichloroethane	ND	ND	<5.0	<5000	<5000	<250
Trichloroethene	0.87-9,500	ND-82	87-170	53000-13000	290-860	4900-9400
Toluene	0.81-110	ND-1.3	<5.0	<5000	<5000	<250
Vinyl Chloride	ND-490	ND	<10.0	<5000	<5000	<250
Xylenes (total)	1.2-2.7	ND	DNA	DNA	DNA	DNA
1,2-Dichloroethene	1.7-6,500	ND-8.1	DNA	DNA	DNA	DNA
1,1,1-Trichloroethane	ND	ND	<5.0	<5000	<5000	<250
Chloroethane	ND	ND	<10	<10000	<10000	<500
Chloromethane	ND	ND	<10	<10000	<10000	<500
Chloroform	ND	ND	<5.0	<5000	<5000	<250
Styrene	ND	ND	DNA	DNA	DNA	DNA
1,1,2,2-Tetrachloroethane	ND	ND	<5.0	<5000	<5000	<250
1,1-Dichloroethene	ND	ND	<5.0	<5000	<5000	<250

Table 5-2 1992 – 1994 Data Summary – Metal Concentration Ranges

Chemical	Sludge (ppm)	Subsoil (ppm)	Monitoring Well RT-1 (mg/L)	Monitoring Well RT-2 (mg/L)	Monitoring Well RT-5 (mg/L)	Monitoring Well RT-4 (mg/L)
Arsenic	0.71-2.1	1.1-7.0	<0.010-0.12	<0.010-0.44	<0.010-0.023	<0.010-0.045
Barium	401-2,060	45.8-111	0.062-0.23	0.062-0.28	0.017-0.43	0.11-0.35
Cadmium	ND	<0.0050	0.0050	0.0050	0.0050	0.0050
Chromium	19,200-55,000	11.2-196	0.013-0.098	41-55	0.021-0.11	<0.010-0.058
Lead	104-638	ND-12.3	<0.005-0.022	<0.005-0.067	0.0056-0.032	<0.005-0.019
Mercury	ND	ND	<0.00020	<0.00020	<0.00020	<0.00020
Selenium	ND	ND	<0.050	<0.020	<0.050	<0.010
Silver	ND-2.6	ND	<0.010	<0.010	<0.010	<0.010

6.0 Task Description and Schedule

6.1 Interim Measures Direct Push Groundwater and Soil Sampling Task

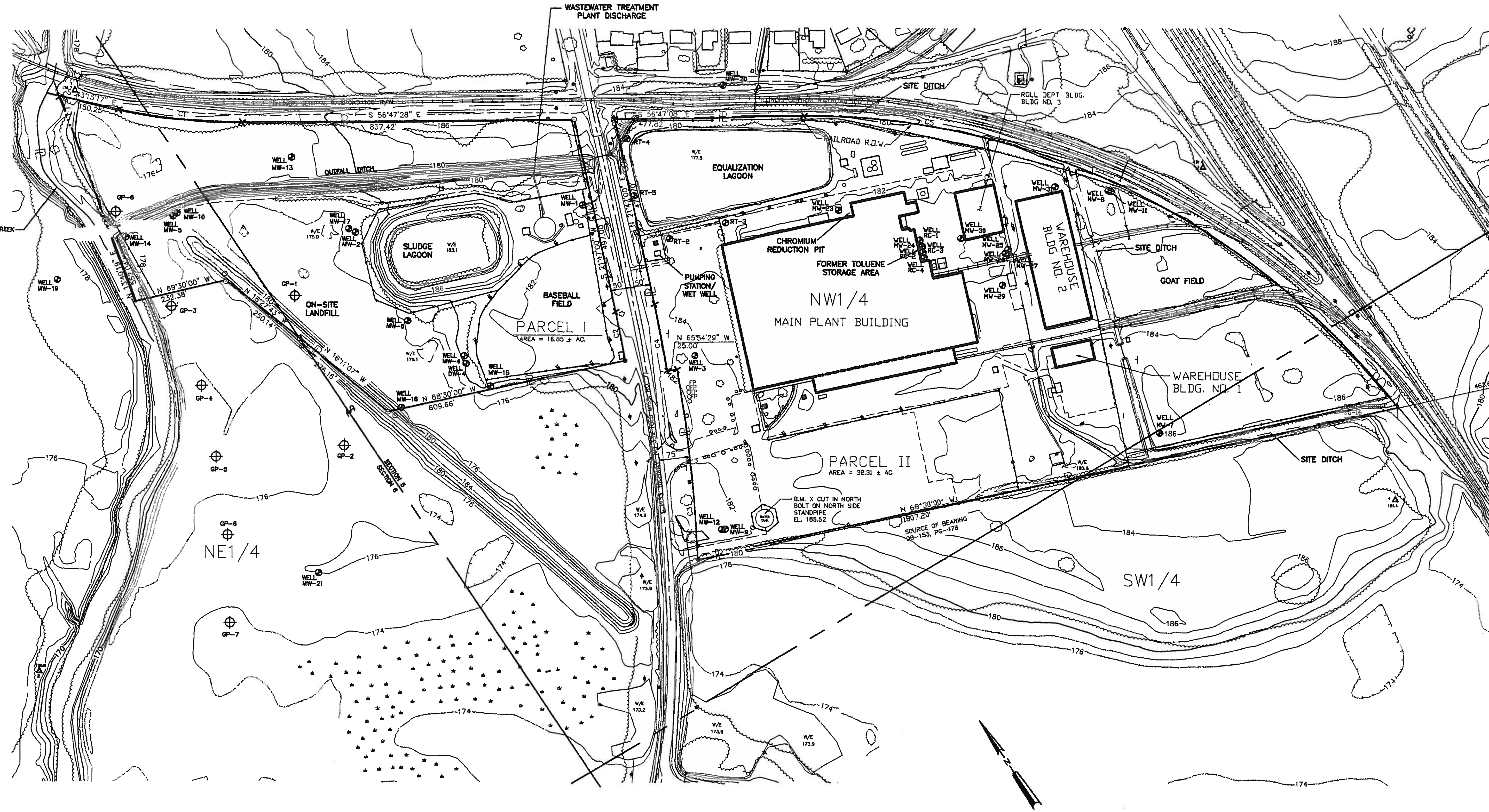
Groundwater sampling using direct-push technology such as Geoprobe® will be conducted to provide additional data to supplement the IM evaluation. The objective of the Geoprobe® groundwater sampling is to determine the lateral and vertical extent of the groundwater plume along Riverdale Creek. Eight Geoprobe® sampling locations (see Figure 6-1) will be used to meet data needs. Two groundwater samples for volatile organic compounds (VOCs) will be collected from each location. One groundwater sample will be collected from the upper ten feet of the water table aquifer (approximately 20 feet) and the second sample will be collected from the lower portion of the aquifer (approximately 45 feet). The sample locations are positioned strategically between the extent of the plumes as currently known and Riverdale Creek to delineate the presence of constituents of concern.

One-inch piezometers will be installed at two locations to better define the groundwater flow direction and gradients in the area immediately upgradient of Riverdale Creek. The piezometers will be installed using direct-push methods within the upper portion of the water table aquifer, (approximately 25 feet). Each piezometer will be completed with a 4-inch diameter locking steel protective casing and surveyed for horizontal and vertical control. Two groundwater elevation measurement events will be performed utilizing the newly installed piezometers along with selected Site wells (approximately 25 locations). The initial event will be completed during the direct-push installation activities, while the second event will be completed about two weeks later.

Continuous soil cores will be collected from direct-push sampling locations GP-4, GP-6, and GP-7 to define the top and bottom of the shallow aquifer. The thickness of the saturated interval and the depths to groundwater and the aquitard are important considerations in selecting a technology with respect to feasibility of construction methods. The groundwater samples and soil cores will be collected in accordance the sampling procedures and requirements presented in Section 9.0.

6.2 Additional Interim Measures Groundwater Monitoring Task

During a meeting held at Grenada Manufacturing on April 25 and 26, 2000 the results of previous investigations and IM were discussed. The USEPA, MDEQ, Grenada Mfg., Meritor, and BC agreed that additional groundwater sampling would be performed to update the groundwater database and incorporate the updated information into the RFI Report (revised SOIW). Accordingly, a site-wide groundwater-sampling event will be conducted to supplement the IM study and update the RFI. Twenty-five (25) monitoring wells will be sampled and analyzed for VOCs, semi-volatile organic compounds (SVOCs), target analyte list (TAL) metals, and hexavalent chromium to assess current groundwater quality at the Site. In addition, these wells will be sampled for field analysis of indicator parameters for biodegradation of VOCs to include carbon dioxide, iron (11), manganese (11), hydrogen sulfide and dissolved oxygen. Table 6-1 presents a list of the monitoring wells to be sampled. The locations of the monitoring wells are presented on Figure 6-1. These 25 wells represent approximately 100 percent of the existing



LEGEND

- Monitoring Well
- Geoprobe Location

250 0 250 500
SCALE FEET

SOURCE: MAP PREPARED BY ALMON ASSOCIATES, 1993. WELL LOCATIONS SHOWN ARE APPROXIMATE.

DRAWING NO.: 19071-010 DATE: 08/21/2000PLOT SCALE 1=250

FIGURE 6-1

MONITORING WELL GEOPROBE LOCATION MAP

GRENADA MANUFACTURING, LLC PLANT
GRENADA, MISSISSIPPI

19071.001 5/00

BROWN AND CALDWELL Nashville, Tennessee

shallow and intermediate wells at the site. Table 6-2 presents the list of laboratory parameters to be analyzed. The available maximum contaminant levels (MCLs) only for the site constituents of concern are presented in Table 6-2. The methods and procedures that will be followed to conduct the groundwater sampling are presented in Section 9.0.

6.3 Equalization Lagoon Closure Sampling Task

Existing monitoring wells MWRT-1, MWRT-2, MWRT-4 and MWRT-5 will be used as sampling locations for the requirements of this monitoring program. These represent locations downgradient of the closed lagoon where potential impacts would be first detected.

Samples will be collected quarterly from each of the four listed wells for the first year of the project. The sampling frequency will drop to twice yearly for the four wells for the second through thirtieth years. Samples will be collected and analyzed for VOCs and TAL metals. Table 6-2 presents the list of laboratory parameters to be analyzed. The available maximum contaminant levels (MCLs) only for the site constituents of concern are presented in Table 6-2. The required methods and procedures to conduct the groundwater sampling are presented in Section 9.0.

Table 6-1 Interim Measures Work Plan – Monitoring Well Network

Well Name
MW-1
MW-2
MW-3
MW-4
MW-5
MW-6
MW-7
MW-8
MW-10
MW-11
MW-12
MW-13
MW-14
MW-15
MW-16
MW-17
MW-20
MW-23
MW-24
MW-25
MWRT-1
MWRT-2
MWRT-3
MWRT-4
MWRT-5

Table 6-2 Parameters to be Measured, Continued

Analyte	CAS #	SW-846 Preparation Method	SW-846 Analytical Method	SW-846 Clean-Up Method	MCLs[b] (ug/L)	Analytical PQL MDL (ug/L)	Laboratory PQL (ug/L)	Laboratory MDL (ug/L)	Equalization Lagoon Analytes
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone)	108-10-1	5030B	8260C	NA		5.0	5.0	2.0	
2-Hexanone	591-78-6	5030B	8260C	NA		5.0	5.0	2.0	
Tetrachloroethene[a]	127-18-4	5030B	8260C	NA	5	5.0	5.0	1.0	X
1,1,2,2-Tetrachloroethane	79-34-5	5030B	8260C	NA		5.0	5.0	1.0	X
Toluene[a]	108-88-3	5030B	8260C	NA	1000	5.0	5.0	1.0	X
Chlorobenzene	108-90-7	5030B	8260C	NA	100	5.0	5.0	1.0	X
Ethylbenzene	100-41-4	5030B	8260C	NA	700	5.0	5.0	1.0	X
Styrene	100-42-5	5030B	8260C	NA	100	5.0	5.0	1.0	X
Xylenes (total)	1330-20-7	5030B	8260C	NA	10,000	5.0	5.0	1.0	X
(m/p-Xylenes)	108-38-3	5030B	8260C	NA		5.0	5.0	1.0	
(o-Xylenes)	95-47-6	5030B	8260C	NA		5.0	5.0	1.0	
Phenol	108-95-2	3510C	8270C	3640A		10	5.0	1.0	
bis(2-Chloroethyl)ether	111-44-4	3510C	8270C	3640A		10	5.0	2.0	
2-Chlorophenol	95-57-8	3510C	8270C	3640A		10	5.0	2.0	
1,3-Dichlorobenzene	541-73-1	3510C	8270C	3640A		10	5.0	2.0	
1,4-Dichlorobenzene	106-46-7	3510C	8270C	3640A		10	5.0	2.0	
1,2-Dichlorobenzene	95-50-1	3510C	8270C	3640A		10	5.0	2.0	
2-Methylphenol	95-48-7	3510C	8270C	3640A		10	5.0	2.0	
2,2-oxybis(1-Chloropropane)	108-60-1	3510C	8270C	3640A		10	5.0	2.0	
4-Methylphenol	106-44-5	3510C	8270C	3640A		10	5.0	4.0	
N-Nitroso-di-n-propylamine	621-64-7	3510C	8270C	3640A		10	5.0	2.0	
Hexachloroethane	67-72-1	3510C	8270C	3640A		10	5.0	1.0	
Nitrobenzene	98-95-3	3510C	8270C	3640A		10	5.0	1.0	
Isophorone	78-59-1	3510C	8270C	3640A		10	5.0	2.0	

7.0 Project Quality Objectives and Measurement Performance Criteria

7.1 Data Quality Objective Process

The following presents the data quality objectives process that has been established for the site.

State the Problem — Provide a description of the problem(s), specifications of available resources, and relevant deadlines for the study.

(1) *Members of the planning team* — The members of the planning team for the RCRA Corrective Action will include John Bozick, Arvin Meritor's Project Manager; Dale Showers, BC's Project Manager; Greg Christians, BC Task Manager; and Ron Burt, BC's QA Officer.

The members of the planning team for the Equalization Lagoon Closure Monitoring will include John Kandler, Textron's Project Manager; Caleb Daba, ECO-Systems Project Manager; Stein Reide, ECO System's Task Manager; and Carol Bullock, ECO-System's QA Officer.

(2) P*rimary decision maker* — There will not be a primary decision maker; decisions will be made by consensus.

(3) *Description of the problem* — See Section 5.2.1.

(4) A*vailable resources and relevant deadlines for the study* — Arvin Meritor and Textron are committed to providing the necessary resources to complete the specified scope of work on the schedule outlined in Section 6.5.

Identify the Decision — Provide a statement of the decision that will use environmental data and the actions that could result from this decision.

(1) *The principal study question* —

RCRA Corrective Action - Is the current distribution of the site parameters of concern consistent with that observed during the initial investigation? Is Riverdale Creek being impacted by site parameters of concern? These questions will be addressed to support the design of IM at the site.

Equalization Lagoon Closure- Is groundwater quality being impacted by the closed Equalization Lagoon?

(2) *Alternative actions that could result from resolution of the principal study question* — The selection and design of site-specific IMs.

(b) *Determine when to collect data.* Groundwater samples will be collected once to supplement IM activities at the site. Groundwater samples will be collected quarterly for the Equalization Lagoon closure monitoring.

(4) *The scale of decision making* — The scale of decision making will be applied to source areas and groundwater at the site.

(5) *Practical constraints on data collection* — The most important practical consideration that could interfere with the study is the inability to collect samples from monitoring wells due to inaccessibility (e.g., vegetative growth and flooding).

Develop a Decision Rule — To define the parameter of interest, specify the action level and integrate previous DQO outputs into a single statement that describes a logical basis for choosing among alternative actions.

(1) *The statistical parameter that characterizes the population of interest* — The planning team is interested in the concentration of site parameters of concern in groundwater.

(2) *Action level for the study* — The action level for the decision will be the RCRA regulatory and site specific risk assessment concentrations developed for the site.

(3) *Decision rule (an "if...then..." statement)* — If the concentration of an individual parameter is greater than the RCRA regulatory and/or site-specific limit, then the parameter will be designated as a parameter of concern.

Specify Tolerable Limits on Decision Errors — Describe the decision maker's tolerable decision error rates based on a consideration of the consequences of making a decision error.

(1) *The possible range of the parameter of interest* — The suspected range of parameters are presented in the RFI Summary Document.

(2) *The decision errors and null hypothesis* —

(a) *Decision errors and the true state of nature for each decision error.* The planning team has determined that the two decision errors are (i) deciding that the parameter is of concern, and (ii) deciding that the parameter is not of concern when it truly is.

(b) *The potential consequences of each decision error.* The consequences of deciding that the parameter is a concern when it truly is not will be that the potential risk of the site will be overstated.

(c) *Which decision error has more severe consequences near the action level* - The planning team has concluded that decision error (ii) has the more severe consequences near the action level due to the potential for understating risk.

7.3 Project Quality Objectives

The precision, accuracy, representativeness, comparability, completeness, and sensitivity of the sampling and analytical procedures must be adequate to allow the data to be used to (1) delineate the constituents of concern in groundwater for the design and implementation of IMs, and (2) compare the concentrations of constituents of concern in groundwater to appropriate standards (see Table 6-2).

Samples will be analyzed in the laboratory for the constituents listed in Table 6-2. These will be analyzed in accordance with USEPA-approved methods. Additional analyses will be conducted in the field to (1) indicate when wells have been sufficiently purged for sampling (pH, conductivity, temperature) and (2) as indicators of natural biological degradation (oxidation/reduction potential-ORP, carbon dioxide, iron (II), manganese (II), hydrogen sulfide, dissolved oxygen).

7.4 Measurement Performance Criteria

Measurement performance criteria (MPC) define the quality elements monitored and the acceptable performance for these elements. Tables 7-1 through 7-4 describe these in detail for accuracy, precision, and sensitivity. For sensitivity, achievement of practical quantitation limits (PQLs) posted in Table 6-2 is sufficient to achieve the project objectives.

Precision is the agreement between a set of replicate measurements without assumption or knowledge of the true value. Precision is assessed by means of duplicate/replicate sample analysis. Precision for the various analytical laboratory processes will be estimated using the relative percent difference in the recoveries between duplicate samples. Matrix spike (MS) and matrix spike duplicate (MSD) samples will be analyzed where appropriate. In most cases, the samples to be used as MS/MSD samples and duplicates will be field duplicates. Precision for some of the analytical methods may also be assessed from the percent recoveries of surrogate spike compounds. Relative percent difference is calculated using one of the following methods:

$$\frac{(R_1 - R_2)x\,100}{R_{Bar}} \quad \text{or} \quad \frac{(S_1 - S_2)x\,100}{S_{Bar}}$$

where R_1, R_2 are the first and duplicate results and R_{Bar} is the average of the two and S_1, S_2 are the spike and duplicate spike results and S_{Bar} is the average of the two. Historical limits for RPD are determined from pairs of either replicates or spikes. The RPDs must be greater than zero to determine upper warning and control limits. Based on Shewhart's model from the Handbook for Analytical Quality Control in Water and Wastewater Laboratories, upper control and warning limits can be determined. The Upper Control Limit for pairs of data can be defined as follows:

$$3.27\ R$$

where R = the average range divided by the number of sets of duplicate measurements. The Upper Warning Limit is set at as 2.51 R.

The spiking procedures will be performed as recommended by the appropriate USEPA methods. The frequency for analysis of spiked duplicate (or replicate) samples will be approximately 1 per 20 samples (excluding QC samples), spaced as evenly through the sequential analysis of samples as practical.

Accuracy is the nearness of a measurement or the mean ($\bar{x}$) of a set of measurements to the true value. Accuracy is assessed by the analysis of reference samples and by percent recoveries of spiked samples. Accuracy for the various analytical processes will be estimated using the recovery of the matrix spiking analytes from MS/MSD samples, other sample spikes as required by the methods, and/or by the analysis of standard reference materials (SRMs). . The Federal Register includes calculations for accuracy on spiked samples for several organics methods. The same calculation may be used for any test amenable to spiking:

$$P = 100(A - B)/T$$

Where:
- P = Percent spike recovery
- A = Concentration determined on spiked sample
- B = Concentration determined on original unspiked sample
- T = True value of spike added

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The data will be reported showing the laboratory MDLs. If a matrix interference or some other analytical problem prevents the attainment of the MDLs, the laboratory Quality Assurance Officer must be immediately notified. The QA Officer will evaluate the problem and contact the project QA Officer for guidance, if necessary.

Analytical results for this project will be reported in the normal turnaround time of 25 business days. Expedited turnaround times are not necessary for the intended use of the data.

Representativeness and comparability of the data will derive from the application of standard, approved methods for sampling and analysis and, therefore, might be called into question in instances where deviations from these methods are required or where inconsistent comparisons of blanks and samples indicate suspect results.

Completeness of the data sets will be judged based upon the usability of the data for the purposes described. The sampling programs have been designed robustly so that up to 10 percent of the results are potentially expendable. However, certain data locations and constituents may be considered critical in combination with others if missing simultaneously. Therefore, each data set will be considered independently and, in the case of periodic events for the Equalization Lagoon Closure monitoring, relative to previous sampling events, to determine whether it completely achieves project objectives. If critical deficiencies occur, additional samples will be collected.

All indicator field measurements are non-critical data.

Table 7-1 Measurement Performance Criteria

Matrix Parameter Level	Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)[3]	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Water VOC Low	5030	8260B	Overall Precision	Within limits on Tables 7-2 – 7-4	Field Duplicates	S&A
			Laboratory Precision	Within limits on Tables 7-2 – 7-4	Matrix Spike and matrix spike duplicates	S&A
			Accuracy - Laboratory	Within limits on Tables 7-2 – 7-4	Matrix Spike and matrix spike duplicates	S&A
			Accuracy - Laboratory	Within limits on Tables 7-2 – 7-4	Laboratory Control samples	A
			Accuracy - Contamination	None >QL	Method Blanks/Equipment Blanks/Trip Blanks/Field Blanks	S&A
			Sensitivity	Calibration to QL	Verify low cal std is at QL	A
Water SVOC Low		8270C	Overall Precision	Within limits on Tables 7-2 – 7-4	Field Duplicates	S&A
			Laboratory Precision	Within limits on Tables 7-2 – 7-4	Matrix Spike and matrix spike duplicates	S&A
			Accuracy - Laboratory	Within limits on Tables 7-2 – 7-4	Matrix Spike and matrix spike duplicates	S&A
			Accuracy - Laboratory	Within limits on Tables 7-2 – 7-4	Laboratory Control samples	A
			Accuracy - Contamination	None >QL	Method Blanks/Equipment Blanks/Trip Blanks/Field Blanks	S&A
			Sensitivity	Calibration to QL	Verify low cal std is at QL	A
Water Metals		6010B/7470A/7196A	Overall Precision	Within limits on Tables 7-2 – 7-4	Field Duplicates	S&A
			Laboratory Precision	Within limits on Tables 7-2 – 7-4	Laboratory duplicates	S&A
			Accuracy - Laboratory	Within limits on Tables 7-2 – 7-4	Matrix Spike	S&A
			Accuracy - Laboratory	Within limits on Tables 7-2 – 7-4	Laboratory Control samples	A
			Accuracy - Contamination	None >QL	Method Blanks/Equipment Blanks/Trip Blanks/Field Blanks	S&A
			Sensitivity	Calibration to QL	Verify low cal std is at QL	A

Table 7-2 Analytical Laboratory Data Quality Objectives for Precision and Accuracy for Volatile Organic Compound Analyses

Parameter	Matrix	QC Compounds	Field[a] Duplicate Precision (RPD) %	MS/MSD Precision (RPD)[b] %	Blanks	LCS & MS/MSD[b] Accuracy (% R)	Surrogate[b] Accuracy (% R)
Volatile Organic	Aqueous	All analytes 1,1-Dichloroethene Trichloroethene Benzene Toluene Chlorobenzene Toluene-d_8 Bromofluorobenzene 1,2-Dichloroethane-d_4	≤30	 ≤ 14 ≤ 14 ≤ 11 ≤ 13 ≤ 13	< 2.5 x RL for methylene chloride; <5 x RL for acetone, 2-butanone; <RL for all other analytes	 61-145 71-120 76-127 76-125 75-130	 88-110 86-115 76-114

NOTES:

[a] Provisions for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] Limits are based on those given in the USEPA Contract Laboratory Program, Statement of Work for Organic Analysis, Multi-media, Multi-concentration Revision OLMO3.1. Actual limits will vary with the historical limits established by each individual laboratory.

Table 7-3 Analytical Laboratory Data Quality Objectives for Semivolatile Organic Compound Precision and Accuracy

Parameter	QC Compounds	Field [a] Duplicate Precision (RPD) %	MS/MSD[b] Precision (RPD) %	Blanks	LCS & MS/MSD [a] Accuracy (% R)	Surrogate [a] Accuracy (% R)
Semivolatile Analysis	All analytes	≤50		≤ 5x RL for phthalates ≤ RL for all others		
	Phenol		≤ 42		12-110	
	2-Chlorophenol		≤ 40		27-123	
	1,4-Dichlorobenzene		≤ 28		36-97	
	N-Nitroso-di-n-propylamine		≤ 38		41-116	
	1,2,4-Trichlorobenzene		≤ 28		39-98	
	p-Chloro-m-cresol		≤ 42		23-97	
	Acenaphthene		≤ 31		46-118	
	4-Nitrophenol		≤ 50		10-80	
	2,4-Dinitrotoluene		≤ 38		24-96	
	Pentachlorophenol		≤ 50		9-103	
	Pyrene		≤31		26-127	
	Nitrobenzene-d_5					35-114
	2-Fluorobiphenyl					43-116
	Terphenyl-d_{14}					33-141
	Phenol-d_5					10-110
	2-Fluorophenol					21-110
	2,4,6-Tribromophenol					10-123
	2-Chlorophenol-d_4					33-110 *
	1,2-Dichlorobenzene-d_4					16-110 *

NOTES:

* Advisory Limits Only

[a] Provisions for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] Limits are based on those given in the USEPA Contract Laboratory Program, Statement of Work for Organic Analysis, Multi-media, Multi-concentration Revision OLMO3.1. Actual limits will vary with the historical limits established by each individual laboratory.

Table 7-4 Analytical Laboratory Data Quality Objectives for Precision and Accuracy for Inorganic Compound Analyses

Parameter	Matrix	QC Compounds	Field [a] Duplicate Precision (RPD) %	Sample/MD Precision[a] (RPD)*	MS Accuracy[b] (% R)	Blanks	LCS/SRM Accuracy (% R)
Inorganics: Metals	Water	All analytes	≤50	<50% RPD for results >5x RL; difference <± 2x RL for results <5x RL	75-125 [b]	< ± RL	80-120

NOTES:

[a] Provisions for wider acceptance limits near the RL may be based on professional judgment during data review/validation.

[b] Unless the sample concentration exceeds the spike added concentration by a factor of 4 or more.

8.0 Inspection/Acceptance Requirements for Supplies and Consumables

For this project, critical supplies will be tracked in the following manner.

Critical Supplies and Consumables	Inspection Requirements and Acceptance Criteria	Responsible Individual
Sample containers and lids	Visually inspected upon receipt for cracks, breakage, cleanliness. Must be accompanied by certificate of analysis.	Field Team Leader
Field measurement equipment	Functional checks to ensure proper calibration and operating capacity	Field Team Leader
Sampling equipment	Visually inspected for obvious defects, damage, and contamination	Field Team Leader

Supplies and consumables not meeting acceptance criteria will initiate the appropriate corrective action. Corrective measures may include repair or replacement of measurement equipment, and/or notification of vendor and subsequent replacement of defective or inappropriate materials. All actions will be documented in the project files.

9.0 Sampling Procedures and Requirements

The additional groundwater, Equalization Lagoon Closure, and Geoprobe® samples will be collected by the methods and procedures in the following sections.

9.1 Groundwater Sampling

Each of the wells for (1) the Interim Measure Additional Sampling and (2) the Equalization Lagoon Closure monitoring will be sampled according to the following procedures:

- The depth to static water level and the total depth will be measured in the well using a hand-held electric water level indicator.

- The volume of standing water in the 2-inch diameter well will be calculated using the following formula:

  $V = 0.164h$

  where:

  V = volume of water (in gallons)
  h = length of water column (in feet)

- A submersible pump or a dedicated/disposable Teflon® bailer will be used to purge a minimum of three standing well volumes from the well prior to sample collection. Purged water will be measured for pH, temperature, oxidation-reduction potential (ORP) and specific conductance to ensure that relatively stable values (i.e., values within 10 percent of previous readings) for these parameters have been achieved prior to sampling. (ORP is not required for the Equalization Lagoon Closure monitoring.)

- When the aforementioned criteria have been satisfied, groundwater samples will be collected in the appropriate, properly labeled sample containers. VOC samples will be collected using dedicated/disposal Teflon® bailers whereas other parameters will be sampled using the submersible pump.

- The samples will be kept on ice immediately upon collection and thereafter during shipment to the laboratory and until analyses are performed. The samples will be shipped using proper chain-of-custody procedures (see Section 10.4).

- An alternate groundwater sampling technique called Low Flow/Low Stress Sampling Technique may be followed for the Equalization Lagoon Sampling. Groundwater monitoring wells will be initially purged using a low-flow/low-stress technique prior to collecting a groundwater sample. This technique will consist of slowly lowering dedicated tubing connected to a peristaltic pump into a region of adequate permeability within the screened portion of the water-bearing zone, based on the well-specific and local

hydrogeology. The specific depth of sampling for each well will be recorded in the logbook and will be used in all future sampling events to maintain consistency. Purging will commence at a low flow rate and will be adjusted such that the static water level remains constant during the purging and sampling process (e.g., discharge equals recharge). Equilibrium is dependent upon the stabilization of field parameters (pH, temperature, and specific conductivity). In addition, turbidity will be measured to assure that particulates have been minimized prior to sampling. Being sure to maintain the stabilized water level, purging will continue until water quality parameters have stabilized (pH ± 0.04, temperature ± 0.1° C, conductivity ± 5%, and turbidity less than 10 NTUs). Once field parameters have stabilized, a groundwater sample will be collected directly from the discharge stream into a laboratory-supplied sample container. Groundwater samples to be analyzed for volatile analysis will be collected from water in the influent tubing (e.g., prior to entering the pump rotor head assembly) in order to avoid concerns for volatilization inherent to the pumping mechanism (suction lift technique). New tubing will be used for each well, thereby eliminating decontamination requirements. Sample collection and handling procedures previously described will be followed.

A portion of the groundwater collected during the sampling procedures will be field tested for temperature, specific conductance, ORP, and pH.

Temperature will be measured first using a thermometer accurate to the tenth of a degree and the value recorded in the field logbook. The thermometer will be rinsed with deionized water and stored in a plastic carrying case for transport to other sampling locations.

The specific conductance and ORP will be measured using a probe that is field calibrated. The probe will be placed in the sample, readings obtained, and then the value recorded in the field logbook. The probe will be decontaminated between samples with a deionized water rinse and placed in a field carrying case.

The pH will be measured with a pH meter that is field calibrated to standards with pH values of 4.0, 7.0, and 10.0. The clean probe will be inserted into the sample container, the reading recorded in the field log book to the nearest 0.1 pH unit, and the probe rinsed with deionized water and inserted into its carrying case.

The probes will be calibrated daily prior to sampling events. Calibration will be conducted according to manufacturer's specifications.

9.1.1 Special Sampling Procedures for the Interim Measures Additional Sampling

In addition to temperature, pH, ORP, and conductivity, field analyses for the Interim Measures Additional Sampling will also involve the use of field kits to measure carbon dioxide, iron (II), manganese (II), hydrogen sulfide, and dissolved oxygen. The procedures for each of these field analyses vary and will be performed in accordance with the associated operating manuals from the manufacturer (see Appendix A).

During each sampling event, the samples will be accompanied by duplicate samples, equipment blanks, and trip blanks (as described in Table 6-4) to be analyzed for quality assurance/quality control (QA/QC). Procedures for collection of these samples are as follows.

Duplicate samples will be collected at the same time and location as field samples. Duplicates will be evenly split from the same bailer load and equally proportioned into each receptacle for the split duplicate. Sample containers will be labeled such that laboratory personnel are not aware that they are analyzing duplicate samples.

Equipment blanks are intended to assess the potential introduction of contamination during sample collection, handling, and analysis and will be obtained in a fashion that approximates sampling procedures used in the field. Distilled/deionized water will be poured into randomly selected clean bailers or pumps that are used for monitoring well sampling and collected in the appropriate containers for the specified analysis. The samples will be handled and transported as are other groundwater samples.

Trip blanks are used to assess contamination caused by sample handling, transportation, storage, and shipping procedures. Trip blanks will be prepared by the laboratory by placing distilled/deionized water into appropriate sample containers, transporting them to the field, and handling them in the same manner as other samples collected during daily field sampling operations.

The types of containers, preservation methods, and holding times for the various laboratory analyses are prescribed by the laboratory in accordance with USEPA methods and are presented in Section 10.2 and Table 10-1. Holding times will be measured from the time of sample collection.

Sample labels will be placed on all samples and will contain the following information:

- date and time of sample collection
- sample location
- sample number
- analysis to be performed
- sampler's name.

The field logbooks used during sampling procedures will include the following information:

- date and time
- sampling location
- static water level (depth to water)
- depth to bottom of the well
- calculated well volume
- actual evacuation volume and time
- analyses to be performed
- preservation method
- field meter calibration information

- general remarks (weather conditions, etc.).

All entries will be made in indelible ink with a ballpoint pen and will be written legibly. Entry errors will be crossed out with a single line, dated, and initialed by the person making the correction. Field logbooks will be reviewed periodically by the Task Manager, as appropriate.

A chain-of-custody form will be completed after sample collection and master field log documentation. The chain-of-custody forms will accompany the samples to the laboratory. The field personnel collecting the samples will be responsible for the custody of the samples until transportation to the laboratory. Sample transfer will require the individuals relinquishing and receiving the samples to sign, date, and note the time on the chain-of-custody forms.

9.2 Direct-Push Sampling

Geoprobe® groundwater sampling will be conducted to provide additional data to supplement the Interim Measures evaluation. The objective of the Geoprobe® groundwater sampling is to assess the lateral and vertical extent of the groundwater plume along Riverdale Creek. Eight Geoprobe® sampling locations (see Section 6.0) will be used to meet this data need. Two groundwater samples will be collected from each location. One groundwater sample will be collected for the upper ten feet of the water table aquifer (approximately 20 feet BGS) and the second sample will be collected from the lower portion of the aquifer (approximately 45 feet BGS). Additionally, soil samples will be collected from GP-4, GP-6, and GP-7 to determine the elevation of the top of the aquitard.

Groundwater samples will be collected with a direct-push sampler. The decontaminated sampler will be driven to the desired sampling depth. The sampler barrel will be retracted to expose the sampler screen allowing groundwater to flow into the sampler. A peristaltic pump with tygon tubing will be used to purge approximately three sampler volumes. Once the sampler has been purged, a groundwater sample will be collected through the pump in 40-ml containers for VOC analyzes. The samples will be handled and labeled in accordance with the groundwater sampling section.

In addition to the groundwater samples, trip blanks, duplicate sample, and an equipment blank will be collected for quality assurance/quality control (QA/QC) in accordance with Table 6-4.

All purge water developed during the sampling event will be placed into 55-gallon drums and stored on Site. The results of the groundwater analyses will be used to characterize the purge water for proper disposal by Arvin Meritor or Textron.

Soil cores will be collected to evaluate the thickness and elevation of the top of the aquitard. A direct push soil sampler will be used to collect continuous soil cores from the surface to the top of the aquitard. Each soil core will be visually inspected and the geologic materials logged in the field notebook, specifically noting the depth to which the aquitard was encountered.

9.3 Decontamination

An important aspect of quality control is the decontamination of field equipment. Improperly cleaned equipment can lead to cross-contamination and misinterpretation of data. Decontamination procedures for this project are outlined in the following paragraphs.

Water Level Indicators

Upon completion of the liquid measurements in the monitoring wells, the probe will be raised to the surface and along with the wetted portion of the tape will be decontaminated with the following procedure:

- Wash in potable water and laboratory detergent
- Rinse with potable water
- Rinse with deionized water

For wells that are located around the perimeter of the Site and which are expected to contain relatively low concentrations of dissolved contaminants with respect to historical data, only the last two steps will be performed.

Submersible Sampling Pumps

Submersible pumps will be cleaned prior to and between each use. Pump tubing will be discarded after each use.

The cleaning process will consist of the following:

- The external surface will be scrubbed with a potable water/detergent solution.
- Flush laboratory detergent and potable water solution through the pump.
- Rinse the external surface of the pump.
- Flush two gallons of potable water through the pump.
- Rinse the internal and external surface of the pump with deionized water.

The power leads to the pump will be decontaminated in a similar fashion.

MISCELLANEOUS EQUIPMENT

- Wash the external and internal surfaces with a potable water/detergent solution.
- Rinse with potable water.
- Rinse with DI water.

10.0 Sample Handling, Tracking and Custody Requirements

10.1 Sample Collection Documentation

The field logbooks used during sampling procedures will include the following information:

- date and time
- sampling location
- static water level (depth to water)
- depth to bottom of the well
- calculated well volume
- actual evacuation volume and time
- analyses to be performed
- preservation method
- field meter calibration information
- general remarks (weather conditions, etc.).

All entries will be made in indelible ink with a ballpoint pen and will be written legibly. Entry errors will be crossed out with a single line, dated, and initialed by the person making the correction. Field logbooks will be reviewed periodically by the Task Manager, as appropriate. Additionally, a field sampling data sheet (see Figure 10-1 and 10-2) will be completed for each sample.

10.2 Sample Preservation, Container Specification, and Holding Time Requirements

The sample container, volume and preservation table and sample naming conventions are provided in the following sections. Table 10-1 presents the sample preservation, container specification, and holding time requirements.

Table 10-1 Sample Preservation, Container Specification, and Holding Time Requirements

Matrix	Parameter/ Method	Sample Container(s)	Recommended Sample Size	Preservative	Holding Time
Water	Metals/mercury 6010B/7470A	Plastic	1000 ml	Cool, 4°C; Nitric acid to pH≤2	180 days all except mercury/ 28 days mercury only
	VOA/8260	VOC Vials-(3) No Headspace	40 ml	Cool, 4°C;HCl to pH≤2	14 days
	SVOA/8270	Amberglass/teflouride 2 per location	1000 ml	Cool, 4°C	7 days extractoin 40 days analysis
	Crt6/7196A	Plastic	500 ml	Cool, 4°C	24 hrs.

Samples will be named as follows:

- Geoprobe - - GP to indicate Geoprobe followed by a number 1 through 8 as shown on Figure 6-1.
- Monitoring wells - - MW GRRT indicate monitoring well followed by a number 1 through 25 as shown in Figure 6-1.

Figure 10-1: Groundwater Sampling Field Data Sheet

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GROUNDWATER SAMPLING FIELD DATA SHEET

Location No. _____

Sample No. _____

Project: _____ **Date:** _____ **Time:** _____

Client: _____ **Weather Conditions:** _____

Job No.: _____ **Air Temperature:** _____

Personnel: _____

Comments:

WELL DATA:

Casing Diameter (in.) _____ Stainless Steel Steel PVC Teflon

Intake Diameter (in). _____ Stainless Steel Steel PVC Teflon Open Rock

Bottom Depth (ft.) _____ Datum Top of Pro. Casing Datum Top of Well Casing Other: _____

Static Water Level (ft.) _____ Well Bottom Clean Well in Good Condition

Volume of Water in Well (gal.): _____

PURGING DATA:

Method: Bladder Peristaltic Bailer Submersible Was The Well Evacuated?

Materials: Teflon Stainless Steel PVC Other: _____ Materials: Teflon Polypropylene Nylon Other: _____

Pump/Bailer: Tubing/Rope:

Purging Equipment: Dedicated Prepared Off-site Field Cleaned

Purge Start Time _____ Purge End Time _____ Volume Pumped _____

Time Series Data: Volume Temperature Ph Spec. Cond. Color

SAMPLING DATA:

Method: Bladder Pump Peristaltic Pump Bailer Submersible Pump

Materials: Teflon Stainless Steel PVC Other: _____ Materials: Teflon Polypropylene Nylon Other: _____

Pump/Bailer: Tubing/Rope:

Sampling Equipment: Dedicated Prepared Off-site Field Cleaned

Metals Sample Field Filtered Filtering Method: _____

PHYSICAL & CHEMICAL DATA:

Appearance: Clear Turbid Color: _____

Contains Immiscible Liquid Other: _____

Field Determinations: Temperature _____ pH _____ Spec. Cond. _____

I Certify that this sample was collected and handled in accordance with applicable regulatory and corporate protocols.

_____ _____

Signature Date

Figure 10-2
GROUNDWATER SAMPLE COLLECTION REPORTS

Location No. _____

Sample No. _____

Project: _____ **Date:** _____ **Time:** _____

Client: _____ **Weather Conditions:** _____

Job No.: _____ **Air Temperature:** _____

Personnel: _____ **Type of Sample:** Water Soil

Physical Description of Sample Location: Bottom Sediment

(If required) _____ Solid: _____

_____ Other: _____

PREPARATION FOR SAMPLING:

Has equipment been dedicated to sample location?

Has equipment been prepared off site prior to sampling?

Has equipment been cleaned and reused in field?

Cleaning Method: _____

Other Data:

COLLECTION OF SAMPLE:

Equipment Utilized: _____

Method: _____

Sample Type Composite Grab Other: _____

Other Data:

FIELD MEASUREMENT DATA:

Appearance: _____

Odor: Yes _____ No

Field Determinations:

Temperature : _____ **pH:** _____ **Spec. Cond.** _____

Other(s): _____ _____ _____

_____ _____ _____

REMARKS:

I CERTIFY THAT THIS SAMPLE WAS COLLECTED AND HANDLED IN ACCORDANCE WITH APPLICABLE REGULATORY AND CORPORATE PROTOCOLS. THESE DATA ARE COMPILED FROM FIELD RECORDS IN A BOUND FIELD BOOK.

_____ _____

Signature Date

10.3 Sample Chain-of-Custody

A chain-of-custody (COC) form will be completed after sample collection and master field log documentation. The chain-of-custody forms will accompany the samples to the laboratory. The field personnel collecting the samples will be responsible for the custody of the samples until transportation to the laboratory. Sample transfer will require the individuals relinquishing and receiving the samples to sign, date, and note the time on the chain-of-custody forms.

10.4 Laboratory Chain of Custody Procedures

Laboratory custody procedures for sample receiving and log-in; sample storage; tracking during sample preparation and analysis; and storage of data are described in the laboratory SOPs and laboratory Quality Manuals. A summary of the process is described below.

On arrival at the laboratory, all samples will be inspected thoroughly to confirm that the integrity of the samples and containers has not been compromised. The cooler custody seals will be inspected to verify that they are still intact and were properly signed and dated by the field sampling team. The temperature of the cooler temperature blank will be determined and recorded. If the temperature of the cooler blank does not fall into the range of 4±2 °C the Project Manager will be notified immediately. The exception to this will be if samples are delivered from the site same-day to the laboratory. In this circumstance the cooler temperature blank and samples may not have cooled during transport and elevated temperatures will be considered acceptable as long as ice is present in the cooler. The individual sample containers will be inspected to verify that each has a sample label. The condition of the samples will be noted on the COC form.

The sample containers will be checked against the accompanying COC to verify that the cooler contents are identical to the samples described on the COC documents. If discrepancies exist, they will be reported to the Laboratory Project Manager, who will immediately notify the Project Manager. The problem will be resolved, in writing, before analytical work begins.

After the Laboratory Sample Custodian has determined that the samples are in satisfactory condition and the documents are in order, a sample log-in sheet will be initiated and will serve as documentation of the condition of the samples upon receipt and their assigned laboratory numbers.

After the samples have been entered into the laboratory tracking system, copies of the log-in forms and COC records will be sent to the Project Manager, who will verify that the specified samples and parameters correspond to the samples and parameters identified in the QAPP. The samples will be placed in a secured storage area, under the conditions called for by the analytical method, until removed for analysis.

Samples delivered on Saturday will be received by the Laboratory Sample Custodian and placed in a secure location until they can be logged in on the next business day.

10.5 Sample Archival

Samples and sample extracts for all analyses will be held under custody at 4±2 °C by the laboratory for 60 days after the laboratory's final report is issued.

11.0 Field Analytical Methods

Conductivity, temperature, pH and ORP meters will be used to collect field measurements. Several other non-critical indicator measurements (carbon dioxide, iron (II), manganese (II), hydrogen sulfide, and dissolved oxygen) will be made in the field as well. The methods and procedures for these measurements are presented in Appendix A.

12.0 Laboratory Analytical Method Requirements

Table 12-1 describes the tests to be performed on the samples collected during this monitoring program.

Table 12-1 Tests and Methods for the Groundwater Monitoring Program

Test	Matrix	SW-846 Method	Laboratory
Metals	Water	6010B/7196A/7470A	ELAB/Pace analytical Services
VOAs	Water	8260B	ELAB/Pace analytical Services
SVOAs	Water	8270C	ELAB/Pace analytical Services

Table 6-2 of this QAPP sets forth the analytes required for each method. Table 6-2 also presents the required extraction and clean-up method for each analyte.

All instruments used to perform chemical measurements must be properly calibrated prior to and during use to ensure acceptable and valid results. This section describes the procedures necessary for maintaining the accuracy of all the instrumentation used in the field tests and the laboratory analyses. The accuracy and traceability of all calibration standards used must be properly documented. The procedures described herein are to be used in conjunction with specific instrument manufacturer's instructions, applicable analytical methodology requirements, and specific laboratory/field procedures for instrument operation.

The require turn-around time for this product is 25 business days.

12.1 Laboratory Instruments

The methodologies selected for use in this investigation specify the types and frequency of calibrations. For all analytical procedures, the lowest calibration standard analyzed must be at or below the project required reporting limit for the specific medium being tested to ensure accurate reporting limit determinations.

Other laboratory equipment such as refrigerators, balances and ovens required for the storage and preparation of samples must be calibrated and/or monitored with the following guidelines:

- Equipment must be checked daily and these records kept in a logbook or calibration-specific log
- The laboratory must document clearly the acceptance criteria for all such equipment (e.g., refrigerator temperature must be 4°C ± 2°C) and corrective actions must be taken for any out-of-control situation as described in the laboratory's Quality Manual
- The equipment must not be used after corrective action until it has been recalibrated or verified through the successful analysis of a check standard
- Calibrations of other miscellaneous analytical equipment (e.g., automatic pipettes) must be performed according to manufacturer's recommendations

Implementation of the laboratory calibrations will be the responsibility of the Laboratory Manager and the analysts performing the procedures.

12.2 Laboratory Instrument Preventative Maintenance

As part of the laboratory's Quality Manual, a routine preventative maintenance program is conducted by the laboratory to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine scheduled maintenance and repair of (or coordinate with the vendor for the repair of) all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications. The preventive maintenance program should include:

- An inventory of replacement and spare parts for instruments that are maintained.
- Maintenance logbooks for each instrument with information on routine and non-routine procedures. The logbook records must include the instrument number, description of malfunction or problem, date of maintenance activity, the type of activity performed, and final resolution.
- Training of laboratory staff in the maintenance requirements of the instruments. Preventive maintenance schedules and activities will be outlined in the laboratory SOPs.

12.2.1 Inductively Coupled Plasma Spectroscopy

The Inductively Coupled Plasma Argon (ICP) Spectrometer should be maintained under service contract with the manufacturer. Routine preventive maintenance should include:

- Checking pump tubing and replacing when necessary.
- Checking nebulizer for even "spray" and cleaning as necessary.
- Checking the torch for plasma height and shape and cleaning as necessary.
- Checking sensitivity of photomultiplier and replacing as necessary.

12.2.2 Gas Chromatograph Instruments

The GC and GC/MS systems will be maintained on a service contract or undergo in-house maintenance to provide routine preventive maintenance. Spare parts for the GC and GC/MS systems should include: filaments, electron multiplier, source parts, o-rings, ferrules, septa, injection port liners, and columns. Routine preventive maintenance for the systems should include:

- Checking the data systems (disk drives, tape readers, etc.) and servicing, as necessary.
- Changing oil and traps on mechanical and turbo pumps.
- Conditioning of moisture traps, every two months or when the gas source is changed.
- Carrier gas evaluation and leak checking of electron capture detector when the gas or column is changed.
- Servicing the MS source through cleaning, replacement of filaments and other source parts, as necessary.
- Replacement of injection port septa and liners, as necessary.

- Clipping the front end of GC column or replacement of GC column, as necessary.

12.2.3 Atomic Absorption Instruments

The atomic absorption (AA) systems will be maintained on a service contract or undergo in-house maintenance to provide routine preventive maintenance. Routine preventive maintenance procedures should include:

- Cleaning the furnace windows.
- Checking the plumbing connections.
- Changing the graphite tube.
- Checking the gases.
- Checking the autosampler and tubing.

12.2.4 Thermometers

Thermometers for refrigerators and ovens are calibrated yearly against National Institute of Standards and Technology (NIST) certified thermometers. The Laboratory QA Officer will be responsible for the safekeeping of the NIST thermometers and for the documentation asserting the accuracy of their measurements.

12.2.5 Analytical Balances

Virtually every analytical procedure requires the use of side-loading and/or top-loading balances. Many of these requirements involve standards preparation and are, therefore, crucial to accurate determination. Balances should be maintained on a service contract. A calibration status label is affixed to each balance after calibration during servicing.

12.3 Inspection/Acceptance Requirements for Supplies and Consumables

For this project, critical supplies will be tracked in the following manner.

Critical Supplies and Consumables	Inspection Requirements and Acceptance Criteria	Responsible Individual
Sample containers/lids	Visually inspected upon receipt for cracks, breakage, cleanliness. Must be accompanied by certificate of analysis.	Requisitioner
Chemicals and reagents	Visually inspected for proper labeling, expiration dates, appropriate grade. Standards must be accompanied by certificate of analysis.	Requisitioner
General Supplies and spare parts	Visually inspected to ensure that the correct items were received in working or usable condition.	Requisitioner

Supplies and consumables not meeting acceptance criteria will initiate the appropriate corrective action. Corrective measures may include repair or replacement of measurement equipment, and/or notification of vendor and subsequent replacement of defective or inappropriate materials. All actions should be documented in the project files.

13.0 Quality Control Requirements

13.1 Sampling Quality Control

Table 13-1 Field Sampling QC for VOC, SVOC and, TAL Metals

Field QC:	Frequency	Method/SOP Acceptance Limits	Corrective Action (CA)	Persons Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Field Blank[1]	1 per medium per 20 field samples collected, or 1 per medium per event if fewer than 20 samples collected.	All compounds of interest ≤ RL	Qualify data	Task Manager	Evaluate cleanliness of sample containers and sample handling and collection procedures	All compounds of interest ≤ RL
Cooler Temperature Blanks	One per cooler.	4± 2°C	Qualify data. Reject data or resample for excessively high temps[2]	QA Coordinator/ Project Manager	Evaluate representativeness and bias	4± 2°C
Field Duplicate[3]	1 per medium per 20 field samples, or 1 per medium per event if fewer than 20 samples collected.	±50% RPD with provisions for wider acceptance limits near the detection limits	Compare to matrix duplicates, check for possible matrix interferences or improper sample collection procedure, qualify data	Data Validator	Evaluate precision and representativeness taking into account variability of sample matrix	±50% RPD with provisions for wider acceptance limits near the detection limits
Matrix spike/ matrix spike duplicate	1 per 20 field samples will be designated for MS/MSD analysis and additional samples volume will be provided for the test.	±50% RPD with provisions for wider acceptance limits near the detection limits	Check for possible matrix interferences, review laboratory procedures for variations or improper sample collection procedure, qualify data	Laboratory Analyst/ Data Validator	Evaluate precision and representativeness taking into account variability of sample matrix and laboratory practices.	±50% RPD with provisions for wider acceptance limits near the detection limits

1. Field blanks are prepared by collecting sample from new building materials with dedicated sampling equipment.
2. The exception to this will be if samples are delivered from the site same day to the laboratory. In this circumstance the cooler temperature blank and samples may not have cooled during transport and elevated temperatures will be considered acceptable as long as ice is present in the cooler.
3. A field duplicate is a split sample with both portions sent to the same lab.
4. A field laboratory split is a split sample with the portions sent to different labs.

13.2 Analytical Laboratory Quality Control

Table 13-2 Laboratory Sample QC Table for VOCs, SVOCs & Metals

Type	Frequency	Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Method Blank	Minimum of 1 per analytical batch or per 20 field samples; whichever is less	All compounds of interest < RL	Reanalyze; if blank still exceeds criteria, clean and recalibrate system; document corrective action, evaluate/reprepare/ reanalyze samples	Laboratory Analyst/Area Manager	Evaluate cleanliness of sample preparation and analysis procedures	All compounds of interest should be < RL
Instrument Blank	As required in method	All compounds of interest < RL	Reanalyze; if second blank exceeds criteria, clean system; document corrective action	Laboratory Analyst	Evaluate cleanliness of instrumentation	All compounds of interest should be < RL
Matrix Spike	At least 1 per preparation batch or as requested on COC	Meet %R requirements in Tables 7-2 and 7-3	Reanalyze samples if necessary. Qualify data if criteria are still not met.	Laboratory Analyst/Area Manager	Evaluate accuracy and representativeness taking into account variability of sample matrix	Meet %R requirements in Tables 7-2 and 7-3
Matrix Spike Duplicates (except metals)	At least 1 per preparation batch or as requested on COC	Meet %R requirements in Tables 7-2 and 7-3	Reanalyze samples if necessary. Qualify data if criteria are still not met.	Laboratory Analyst/Area Manager	Evaluate precision, accuracy, and representativeness taking into account variability of sample matrix	Meet %R requirements in Tables 7-2 and 7-3
Laboratory Duplicate (metals only)	At least 1 per preparation batch or as requested on COC	Meet RPD requirements in Tables 7-2 and 7-3	Reanalyze samples. Qualify data if criteria are still not met.	Laboratory Analyst/Area Manager	Evaluate precision and representativeness taking into account variability of sample matrix	Meet RPD requirements in Tables 7-2 and 7-3
LCS	1 per medium per 20 field samples or per laboratory sample batch, whichever is less	Lab/regulatory generated: recoveries as specified in Tables 7-2 and 7-3	Check if MS/MSD acceptable to compare for matrix effects. Evaluate the bias in relation to sample result. Reanalysis may be required. Data may require qualifiers.	Laboratory Analyst/Area Manager	Evaluate accuracy	Vendor-supplied: Within the 95% confidence interval/ vendor supplied limits Lab-generated: recoveries as specified in Tables 7-2 and 7-3
Initial Calibration	As specified in method	As specified in methods	Recalibrate; check system	Laboratory Analyst	Establish instrument response and linearity.	As specified in methods

Table 13-2 Laboratory Sample QC Table for VOCs, SVOCs & Metals (Continued)

Type	Frequency	Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator	Measurement Performance Criteris
Calibration Check Sample	As specified in method	90-110% recovery for most inorganics; as specified in EPA methods for organics listed in Tables 7-2 and 7-3	Recalibrate; check system, reanalyze affected samples	Laboratory Analyst	Evaluate stability and accuracy of instrumentation.	90-110% recovery for most inorganics; as specified in EPA methods for organics listed in Table 7-2 and 7-3
Surrogates	All GC/MS and GC samples for organic analyses	Recoveries as specified in Table s 7-2 and 7-3	Evaluate data; samples may require reanalysis and/or qualification	Laboratory Analyst/ Area Manager	Evaluate accuracy of sample preparation and effect of matrix on preparation	Recoveries as specified in Table s 7-2 and 7-3

RL = Reporting Limit
MS = Matrix Spike Sample
MSD = Matrix Spike Duplicate Sample
MD = Matrix Duplicate Sample
SRM = Standard Reference Material
LCS = Laboratory Control Sample
RPD = Relative Percent Difference (between duplicate results)
GC = Gas Chromatography
GC/MS = Gas Chromatography/Mass Spectrometry

14.0 Documentation, Records, and Data Management

14.1 Project Documentation and Records

Project documents will be controlled through an organized project filing system. Project and task numbers will be printed on each document. Analytical/technical files will include work products generated during the project. Field books, field observations, photographs, and other field related documents will be prepared and will also be placed in the project files. Laboratory sample results will be controlled, reviewed, and validated. Original incoming documents will be date-stamped upon arrival and will be placed in the files.

The project manager will contact the analytical laboratories, subcontractor, or privates' sources twice prior to receiving the data report to review the report status. This will provide an opportunity to identify potential QA issues or potential delivery delays. This will also provide an opportunity to implement corrective actions when most appropriate.

Data received from the field, analytical laboratories, subcontractors, or private sources will be tabulated on a spreadsheet or database and will be subjected to quality control procedures, including comparing raw data to the original source, verifying calculations, and confirming data summaries. Data distribution will not occur until data review has been completed.

Work products will be checked before final use. This includes checking calculations, reports, plans, etc. with various levels of review. The Project Manager will be responsible for the review of work as an element of his project responsibilities. The Principal-In-Charge is responsible for the overall quality of the work. One or more discipline-specific Technical Directors may be assigned by the Project Manager. Further, assignments may be made outside the project team, as needed, for quality control purposes; for example, utilizing personnel experienced in the monitoring and evaluation of natural attenuation data.

14.2 Laboratory Data Package Deliverables

CLP package deliverables will be required for this project. The laboratory will provide at least two hard-copies of each laboratory data report, an original and a copy for data validation, to the Project Manager. Electronic deliverables will also be required for the project database. Laboratory deliverables use require within 25 days of receiving samples.

14.2.1 Hardcopy Data Package

The laboratory data reports will include a full data package so that a thorough review of all QA/QC can be performed and any matrix or method issues be discovered and resolved. The data package shall consist of the following, at a minimum:

1. Detailed Case Narrative

- Date of issuance
- Laboratory analysis performed, modifications to the methods and impact on the data.
- Any deviations from intended analytical strategy

- Laboratory batch number
- Numbers of samples and respective matrices
- QC procedures utilized and also references to the acceptance criteria
- Laboratory report contents
- Project name and number
- Condition of samples 'as-received'
- Discussion of whether or not sample holding times were met and if holding times were not met a demonstration of the validity of the data.
- Discussion of technical problems or other observations which may have created analytical difficulties
- Discussion of any laboratory QC checks which failed to meet project criteria and the effect on the data.
- Signature of the Laboratory QA Officer and/or Laboratory Director or designee.
- Description of laboratory data qualifiers used
- Definitions of acronyms and qualifiers.

2. Chemistry Data Package

- Report of analysis with units clearly labeled with supporting raw data and expressed to the appropriate number of significant figures.

- Results of method blanks with supporting raw data
- Summary table showing relationship field samples to QC samples
- Surrogate recovery summaries
- Laboratory control sample summary with supporting raw data
- Matrix spike summary with supporting raw data
- Laboratory duplicate summary with supporting raw data (where applicable)
- Matrix spike duplicate summary with supporting raw data (where applicable)
- Tune Summary (GC/MS)
- Initial calibration summary and supporting raw data
- Continuing calibration summary and supporting raw data
- Internal standard summary
- Instrument sensitivity check (CRI or equivalent)
- Interference Check Sample summary
- Run logs
- Sample preparation logs
- Laboratory method detection limits
- ICP linear ranges
- Laboratory acceptance limits for QC samples
- Internal and external chains of custody
- Sample raw data

14.3 Data Tracking, Storage, and Control

The final project files will be maintained by the Project Manager in a secured, limited access area. The content of the project file will include, at a minimum, all relevant records, reports, correspondence, logs, field logbooks, laboratory sample preparation and analysis raw data,

original laboratory data packages, pictures, subcontractor's reports including data validation reports, assessment reports, progress reports, and COC records/forms.

15.0 Assessments and Response Actions

15.1 Planned Assessments

An internal audit of field activities including sampling and field observations will be conducted by the Task Manager early in the project to verify that all established procedures are being followed.

15.1.1 Data Package Technical Systems Audit

Assessment of the analytical information will be accomplished by the joint efforts of the QA Officer and Project Manager. The data assessment by the Project Manager will be based on the criteria that the samples were properly collected and handled according to the Sampling and Analysis Plan and Section 9 of this QAPP.

The QA/QC Director will conduct a systematic review of the data for compliance with the established QC criteria based on the spike, duplicate, and blank results provided by the laboratory. An evaluation of data accuracy, precision, sensitivity, and completeness, based on criteria set forth in Section 7.0 of this QAPP, will be performed and included in the sampling event report.

The Data Review will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

15.2 Assessment Findings and Corrective Action Responses

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of QC performance which can affect data quality and usability. Corrective actions may be required for two classes of problems: analytical and equipment problems and noncompliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review.

For noncompliance problems (e.g., non-compliance with USEPA methods or QC defined in this QAPP) a formal corrective action will be implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Project QA Officer. A description of the problem and the corrective action implemented will be confirmed in writing via email, facsimile, or technical memorandum.

Any nonconformances with the established QC procedures in this QAPP will be identified and corrected on an ongoing basis throughout the course of the project.

The need for corrective action may be identified at anytime during the analytical process. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory. These actions are dependent upon the ability to mobilize the field team and whether the data to be collected is necessary to meet the required QA objectives. If the data validator or data assessor identifies a corrective action situation, the

Project Manager will be responsible for informing the appropriate personnel. All corrective actions of this type will be documented by the Project Manager.

15.3 Additional QAPP Non-Conformances

The purpose of this section is to indicate the methods by which it will be ensured that the data collected for this investigation falls in line with the DQOs as described in Section 6 of this QAPP. To meet these DQOs, a combination of statistical procedures and qualitative evaluations will be used to check the quality of the data. These procedures will be used by the laboratory while generating the data.

Results for QC samples, including field and laboratory blanks, spikes, and duplicates as previously described in Sections 6 and 13 of this QAPP, will be evaluated using the equations in the validation guidelines to determine the validity and usability of the data. In addition, the data will be reviewed for indications of interferences to results caused by sample matrices, contamination during sampling, contamination in the laboratory, and sample preservation and storage anomalies (i.e. sample holding time or analytical instrument problems).

15.3.1 Field Sampling

Technical staff and field project personnel will be responsible for reporting all suspected technical or QA nonconformance or suspected deficiencies of any field collection or observation activity by reporting the situation to the Project Manager or designee. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the field personnel.

The Project Officer will be responsible for ensuring that corrective action for nonconformance are initiated by:

- evaluating all reported nonconformances;
- controlling additional work on nonconforming items;
- determining disposition or action to be taken;
- maintaining a log of nonconformances;
- reviewing nonconformance reports and corrective actions taken; and
- ensuring nonconformance reports are included in the final site documentation in project files.

Corrective actions will be implemented and documented in the field record book. Documentation will include:

- A description of the circumstances that initiated the corrective action,
- The action taken in response,
- The final resolution, and
- Any necessary approvals.

No staff member will initiate corrective action without prior communication of findings through the proper channels.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The Project QA Officer will identify deficiencies and recommend corrective action to the Project Manager. Implementation of corrective actions will be performed by the Field Team Leader (FTL) and field team.

If appropriate, the Project Manager will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

If a corrective action warrants a change in the program protocols, this change will be documented and signed by the FTL and the Project Manager.

15.3.2 Laboratory Analysis

The laboratories participating in this program are required to have a written policy specifying corrective actions to be taken when an analytical error is discovered or the analytical system is determined to be out of control. These policies require documentation of the corrective action and notification by the analyst about the errors and corrective procedures. Corrective action for each laboratory is described in the laboratory Quality Manual.

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is dependent on the analysis and the event. Laboratory corrective actions may be necessary if:

- QC data are outside the acceptable windows for precision and accuracy
- Blanks contain compounds of interest, as listed in tables in Section 6 of this QAPP, above acceptable levels
- Undesirable trends are detected in matrix spike recoveries or RPD between duplicates
- There are unusual changes in detection limits
- Deficiencies are detected by the Laboratory QA Department during internal or external audits or from the results of performance evaluation samples
- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department.

Corrective action may include:

- Re-analyzing the samples, if holding time criteria permits;

- Re-sampling and analyzing;
- Evaluating and amending analytical procedures;
- Accepting data and acknowledging the level of uncertainty as documented in the laboratory data package case narrative.

If re-sampling is deemed necessary due to laboratory problems, the Project Manager will identify the necessary approach including cost recovery for the additional sampling effort.

16.0 QA Management Reports

The final report will contain QA sections in which data quality information collected during the project is summarized. The QA section of the report will contain information generated during the project on the achievement of project-specific DQOs, uncertainties in the data used and their effect on the data usage, and a summary of corrective actions implemented, as necessary, as it may have affected results.

17.0 Verification and Validation Requirements

A validation of the collected data will be conducted that includes a check of the field sample and COC records and a qualitative evaluation of the laboratory data. The laboratory data evaluation will address the use of appropriate analytical methods and analytical detection limits, positive detections in blanks, comparison of data to anticipated results, evaluation of qualified data, comparison to required holding times, and a comparison to respective duplicate samples.

18.0 Verification and Validation Procedures

18.1 Data Validation

18.1.1 Procedures Used to Validate Field Data

The procedures to evaluate field information include checking for transcription errors, ensuring that field measurement equipment was properly calibrated, and review of field logbooks. Historical data from previous site assessments will be compared to the data generated during this assessment. These reviews will be performed by the Field Team Leader.

18.1.2 Procedures Used to Validate Laboratory Data

The data will be assessed for usability, completeness, and adherence to key QA/QC objectives for this project. This data assessment review will include a review of all technical holding times, instrument performance check sample results, initial and continuing calibration results, and all batch and matrix QC including field blanks, field duplicates, MS/MSD, matrix duplicates, surrogate recoveries, method blanks, LCS results, SRM results, and the identification and quantitation of specific compounds of interest.

Additionally, MDL studies for all chemicals of concern in the matrices of interest will be performed by the analytical laboratory. These MDLs must support the project reporting limit requirements and have been performed within one year of the analysis of samples collected for the screening survey. The laboratory shall follow the MDL procedures as outlined in the Federal Register, Vol. 49, No. 209, October 26, 1984, pp.198-199 and associated laboratory QAPP SOPs.

18.2 Overall Assessment of Environmental Data

Data assessment will involve data evaluation and usability to determine if the data collected are of the appropriate quality, quantity and representativeness to support the screening survey. The affect of the loss of data deemed unacceptable for use, for whatever reason, will be discussed and decisions made on corrective action for potential data gaps. The QC results associated with each analytical parameter for each matrix type will be compared to the objectives presented in Sections 6 and 13 of this QAPP. Only data generated in association with QC results meeting these objectives and the data validation criteria will be considered usable.

Factors to be considered in the overall data assessment based on the DQOs in this QAPP and the data evaluation by the Data Validator will include, but not necessarily be limited to, the following:

- Were all samples obtained using the methodologies and SOPs proposed in the QAPP?
- Were all proposed analyses performed according to the SOPs provided in the QAPP?
- Were samples obtained from all proposed sampling locations planned?
- Do any analytical results exhibit elevated detection limits due to matrix interferences or contaminants present at high concentrations?

- Were all laboratory data evaluated according to the validation protocols, including project-specific QC objectives as defined in this QAPP?
- Which data sets were found to be unusable (qualified as "R") based on the data evaluation results?
- Which data sets were found to be usable as estimated data, (qualified as "J" or "UJ") based on the data evaluation results?
- Have sufficient data of appropriate quality been generated to support the project?
- Were all issues requiring corrective action, if any, fully resolved?
- Have any remaining data gaps been identified and summarized in the final report?

19.0 Data Usability/Reconciliation with Project Quality Objectives

The goal of this project is to produce data that can be used to further delineate groundwater contamination and to monitor the effects of the Equalization Lagoon Closure on groundwater. As such, the data generated must meet the data user's needs as defined in the project DQOs in Section 6 of this QAPP. In summary from Section 6, the primary objectives for assessing the usability of the data are (1) to collect data that are representative of site conditions that can be combined with prior data; (2) to produce data that meet the project reporting limit requirements.

The Data Validator will apply the standard data validation qualifiers to data to indicate the level of uncertainty in the associated result. In general, for the purposes of the screening survey, data that are left unqualified, data qualified "U" (non-detected), data qualified "J" (detected as an estimated result), and data qualified "UJ" (non-detected at an estimated detection reporting limit) are considered valid and usable for project objectives. Data that are qualified "R" (rejected), due to severe exceedances of QC requirements, will be considered invalid and unusable.

The goal of this program is to generate valid, usable data. However, in environmental sampling and analysis, some data may be lost due to sampling location logistics, field or laboratory errors, or matrix effects that may cause the rejection of results for some compounds. The overall goal for completeness of collection of valid data is 90%. The Data Validator will assess the completeness of the overall data generation against the project goal of producing 90% of the planned data as valid and usable results. If this goal is not met, data gaps may exist that may compromise the intended use of the data.

20.0 Special Training Requirements/Certifications

The field sampling, field analysis, laboratory analyses, and data validation tasks are considered routine tasks and will be performed by a qualified environmental professional. Therefore, these tasks will not require any additional specialized site-specific training.

The Project Health and Safety Plan requires that personnel working on project related field tasks be trained in accordance with the Occupational Safety and Health (OSHA) regulations. Prior to working on-site all potential site personnel will be required to submit certificates of OSHA training to the project manager.

APPENDIX A

FIELD PARAMETER OPERATION MANUALS

CARBON DIOXIDE TEST KIT
Model CA-23
Cat. No. 1436-01

HACH

Low Range

1. Fill the mixing bottle to the 23-mL mark with the water sample.
2. Add one drop of Phenolphthalein Indicator Solution to the sample.
3. Add the Sodium Hydroxide Solution drop by drop to the sample. Count each drop as it is added. Swirl the bottle to mix after each drop is added as shown in Figure 1. Continue adding drops until a light pink color forms and persists for 30 seconds.
4. Each drop of Sodium Hydroxide Solution used equals 1.25 mg/L carbon dioxide (CO_2).

WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the test and use appropriate safety equipment.

HACH COMPANY, P.O. BOX 389, LOVELAND, COLORADO 80359
TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 970-669-3050, TELEX: 160840

dium Range

Fill the mixing bottle to the 15 mL mark with the water sample.

Add one drop of Phenolphthalein Indicator Solution to the sample.

Add the Sodium Hydroxide Solution drop by drop. Count each drop as it is added. Swirl the bottle to mix after each drop is added. Continue adding drops until a light pink color forms and persists for 30 seconds.

Each drop of Sodium Hydroxide Solution used equals 2 mg/L carbon dioxide (CO_2).

h Range

Fill the plastic measuring tube level full with the water to be tested. Transfer to the mixing bottle by placing the mixing bottle over the tube and then turning the bottle right-side up.

Add one drop of Phenolphthalein Indicator Solution to the contents of the mixing bottle.

Add the Sodium Hydroxide Solution drop by drop. Count each drop as it is added. Swirl the bottle to mix after each drop is added. Continue adding drops until a light pink color forms and persists for 30 seconds.

Each drop of Sodium Hydroxide Solution used equals 5 mg/L carbon dioxide (CO_2).

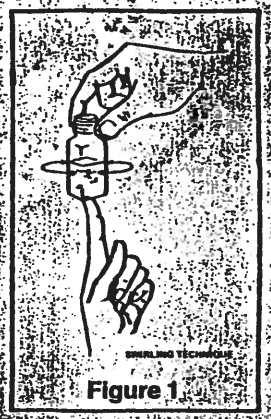

Figure 1

REPLACEMENTS

Cat. No.	Description	Unit
1897-36	Phenolphthalein Indicator Solution, 1 g/L	15 mL (½ oz) SCDB*
671-37	Sodium Hydroxide Solution, 0.01*N*	118 mL (4 oz) MDB†
438-00	Measuring Tube	each
2327-06	Mixing Bottle	pkg/6

*Self-contained Dropping Bottle
†Marked Dropping Bottle

MANGANESE TEST KIT

0-3 mg/L

Model MN-5

Cat. No. 1467-00

HACH

1. Fill a sample mixing bottle to the shoulder with the water to be tested.
2. Use the clippers to open one Bufffer Powder Pillow for Manganese, Periodate Method. Add the contents of the pillow to the mixing bottle. Swirl to mix as shown in Figure 1.
3. Use the clippers to open one Sodium Periodate Powder Pillow. Add the contents of the pillow to the mixing bottle and swirl to mix.
4. A pink color will develop is manganese is present.
5. Allow the prepared sample to stand undisturbed for one minute to allow full color development.
6. Fill one sample tube to the line underlining "Cat. 1730-00" with the prepared sample. This will be approximately 15 mL. If not using 1730-00 tubes, fill to the line found at approximately 3 inches up from the bottom of the tube.

WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the test and use appropriate safety equipment.

HACH COMPANY, P.O. BOX 389, LOVELAND, COLORADO 80359
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7. Place the lengthwise viewing adapter into the comparator as shown in Figure 2.
8. Insert the tube of prepared water sample into the comparator opening labeled Prepared Sample Position in Figure 2.
9. Fill the other sample tube with untreated water or a reagent blank to the line underlining "Cat. 1730-00". Insert this tube into the comparator opening labeled Clear Sample Position in Figure 2.
10. Hold the comparator with the tube tops pointing to a window or light source as in Figure 3. View through the openings in the front of the comparator. When viewing, use care to not spill samples from unstoppered tubes.
11. Rotate the disc to obtain a color match. Read the mg/L manganese (Mn) through the scale window.

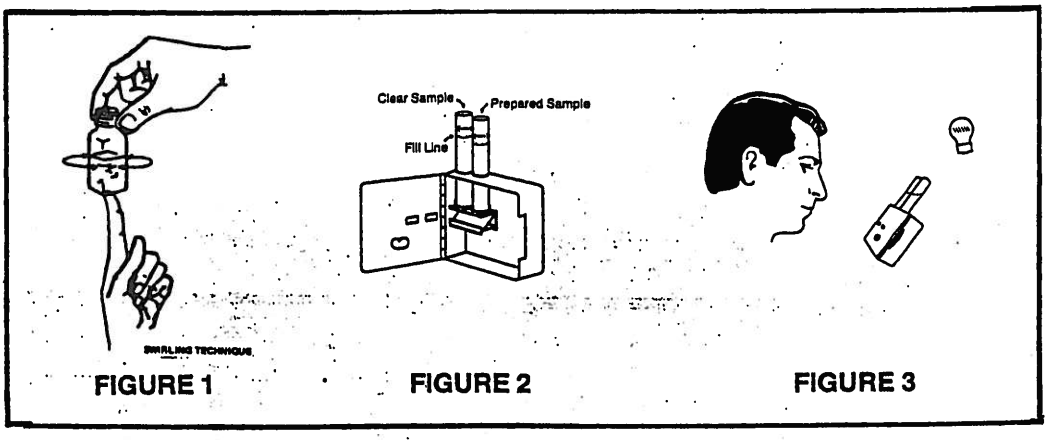

FIGURE 1 FIGURE 2 FIGURE 3

REPLACEMENTS

Cat. No.	Description	Unit
983-66	Buffer Powder Pillows for Manganese, Periodate Method	pk/50
984-99	Sodium Periodate Powder Pillows	pk/100
439-06	Bottle, mixing	pk/6
968-00	Clippers	each
1732-00	Color Comparator	each
1730-00	Color Disc (Manganese)	each
1929-00	Color Viewing Tube	each
24122-00	Lengthwise Viewing Adapter	each
14480-00	Stopper	pk/6

MADE IN U.S.A.

1/90